



**S N BOSE NATIONAL CENTRE  
FOR BASIC SCIENCES**

*Block JD, Sector III, Salt Lake, Kolkata 700 106*

## **DEPARTMENTAL SEMINAR**

# **Department of Astrophysics and High Energy Physics**

**28<sup>th</sup> November, 2023**

**11.00 AM**

**BOSON / ONLINE**

### **SPEAKER**

**Dr. Ayan Mitra,**  
**Post-Doctoral Fellow, IUCAA, India**

### **TITLE OF THE TALK**

**Using Photometric Redshifts to Improve Dark Energy Constraints  
with Type Ia Supernova in the LSST Era**

### **ABSTRACT**

We perform a rigorous cosmology analysis on simulated type Ia supernovae (SN-Ia) and evaluate the improvement from including photometric host-galaxy redshifts compared to using only the "zspec" subset with spectroscopic redshifts from the host or SN. We use the Deep Drilling Fields ( $-50 \text{ deg}^2$ ) from the Photometric LSST Astronomical Time-Series Classification Challenge (PLaSTiCC), in combination with a low- $z$  sample based on Data Challenge2 (DC2). The analysis includes light curve fitting to standardize the SN brightness, a high-statistics simulation to obtain a bias-corrected Hubble diagram, a statistical+systematics covariance matrix including calibration and photo- $z$  uncertainties, and cosmology fitting with a prior from the cosmic microwave background. Compared to using the zspec subset, including events with SN+host photo- $z$  results in i) more precise distances for  $z > 0.5$ , ii) a Hubble diagram that extends 0.3 further in redshift, and iii) a 50 % increase in the Dark Energy Task Force figure of merit (FoM) based on the  $w_0$ - $w_a$  CDM model. Analyzing 25 simulated data samples, the average bias on  $w_0$  and  $w_a$  is consistent with zero. The host photo- $z$  systematic of 0.01 reduces FoM by only 2 % because i) most  $z < 0.5$  events are in the zspec subset, ii) the combined SN+host photo- $z$  has X 2 smaller bias, and iii) the anti-correlation between fitted redshift and color self corrects distance errors. To prepare for analysing real data, the next SNIa-cosmology analysis with photo- $z$ 's should include non SN-Ia contamination and host galaxy mis-associations.

### **HOST FACULTY**

**Dr. Tapas Baug, Assistant Professor**  
**Dept. of ASTROPHYSICS AND HIGH ENERGY PHYSICS**

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